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Arnold W. Norden and Donnell E. Redman, Editors

Mailing Date: March 7, 2000

Cover Photograph: Thomas Milton Oler, Jr.(on right, with Arnold Norden and Clayton Ray), on the job at the Natural History Society of Maryland, overseeing the transfer of a fossil crocodilian from the NHSM collection to the Museum of Natural History, Smithsonian Institution. When Milton passed away this year at the age of 97, he had been a member of the Society for 65 years. Photograph taken in 1981 by Daniel J. Lyons.

The Maryland Naturalist 43(3-4):1-6 July/December 1999

Reproduction and Health of a Beaver (*Castor canadensis*) Population in Prince William County, Virginia

Timothy R. Brophy and Carl H. Ernst

Abstract.-Reproduction and health were studied in a beaver (*Castor canadensis*) population from Prince William County, Virginia during 1998. Copulating beavers were observed in Quantico Creek at Prince William Forest Park on 22 January. Seven females from Quantico Marine Base were trapped between January and May, sacrificed, and dissected. Those reproductively active weighed over 39 pounds (17.7 kg) and were trapped before 1 March. Mean litter size based on counts of corpora lutea was 4.80 young (3-7); however, litter size based on the number of embryos present was only 2.75 (1-3), comparable to most others reported in the literature. Five of the seven dissected females had prime pelts, one an average pelt, and one a poor quality pelt. Subcutaneous fat deposits and those at the base of the tail were moderate to high in all females. Four contained moderate mesenteric deposits, while three had low to no mesenteric fat present. No abnormalities were found in the heart, lungs, liver, kidneys, or bladder. Four females had suffered wounds to either the tail and/or body, possibly from male courtship. The females harbored two of the most common beaver helminths: the stomach nematode, *Travassosius americanus* (100% incidence) and the cecal trematode, *Stichorchis subtriquetrus* (86% incidence). Compared to other reported studies, these worm burdens were moderate to average.

Introduction

With the development of the fur trade in the eighteenth and nineteenth centuries, the beaver (*Castor canadensis*) became the most widely and intensively sought natural resource in North America. Beaver pelts were so sought after that eastern populations were severely decimated and almost extinct in the mid-Atlantic region by 1900. The beaver was extirpated in Virginia by 1911 (Hill 1976), and those in northern Virginia also disappeared during this period (Handley 1991). In the early 1950s, Virginia's Commission of Game and Inland Fisheries reintroduced *C. c. canadensis* into northern Virginia where it exists today. Since its reintroduction, it has invaded new waterways and increased in numbers to the point of often being a destructive nuisance (Davis 1992).

Despite their impressive comeback in northern Virginia, little is known about current beaver populations other than scattered anecdotal information. As part of an intensive population study (Ernst and Brophy 1998) at Prince William Forest Park and Quantico Marine Base (Prince William County, Virginia), reproduction and health were assessed.

Methods and Materials

Beavers were trapped at Quantico Marine Base as part of an ongoing beaver management plan. Traps used were 330 Conibears set in natural or fabricated channels leading to a scent mound. Seven female beavers were captured between 23 January and 26 April 1998, weighed in the field, and immediately brought to the laboratory at George Mason University

Upon arrival, beavers were dissected to determine their reproductive status. Dates of individual dissections were recorded to correlate embryonic development throughout the season. The female reproductive tract was removed above mid-vagina and the uterus was incised to allow examination for embryos. The number of corpora lutea on each ovary and the number of embryos in each uterine horn were recorded from the fresh reproductive tracts. Embryos present were measured with a metric ruler to the nearest 0.5 mm. Additional reproductive data were based on field observations by the authors and their trapper.

The same dissected females were examined to determine health status. The amount of subcutaneous and mesenteric fat deposition (high, moderate, low) was noted, as was the amount of deposited tail fat. Condition of the pelt (prime, average, poor) was also recorded and any wounds on the body or tail noted. In addition, the digestive tract was excised from the lower esophagus to the rectum. A lengthwise incision was made along the entire tract and the stomach, intestines, and cecum were examined macroscopically for parasitic helminths. The heart, lungs, liver, kidneys, and bladder were also dissected and examined for parasitic worms. The site and number of any worms present were noted. Worms were fixed in 40% neutral formalin and transferred to 70% ethanol after 48 hours for preservation and future identification.

Results and Discussion

Reproduction

Copulating beavers were observed in Quantico Creek at Prince William Forest Park on 22 January 1998 (Andrew Angelacci, pers. comm.). In North America, *C. canadensis* experiences one reproductive cycle per year. Mating usually takes place in the winter, normally in January or February, but sometimes occurs as early as December (Bergerud and Miller 1997, Hodgdon and Hunt 1953).

Reproductive data for the seven dissected females are presented in Table 1. The earliest collection date of a pregnant female during the current study was 25 January 1998, indicating a December or early January mating. The last pregnant female was trapped on 1 March 1998. No lactating females were captured. The seven dissected females averaged 18.2 kg (40.1 lbs.) and ranged from 8.2-25.9 kg (18-57 lbs.). Those over 17.7 kg (39 lbs.) were reproductively active. Yearling females trapped on 1 March (8.2 kg, 18 lbs) and 26 April (9.5 kg, 21 lbs.) showed no signs of reproductive activity. This is not surprising, as both sexes of beaver become sexually active at about 1.5-2.0 years of age (Brenner 1964, Henry and Bookhout 1969, Larson 1967).

Table 1. Reproductive data for seven female beavers collected at Quantico Marine Base, Virginia.

Collection Date	Weight (lbs.)	Corpora Lutea	Embryos	Embryo Length
1/23/98	53	1L:4R	0	N/A
1/25/98	57	2L:3R	2L:1R	1-2 mm
2/10/98	51	1L:3R	1L:0R	1-2 mm
2/15/98	42	1L:2R	1L:2R	3.5-4 mm
3/1/98	39	3L:4R	3L:1R	6-7 mm
3/1/98	18	0	0	N/A
4/26/98	21	0	0	N/A

Mean litter size in this study, based on the number of corpora lutea present on the ovaries of five adult females, was 4.80 (3-7). The right ovary was more active in these females, ovulating 16 eggs compared to only eight by the left ovary. Mean litter size, based on embryos present in four of the adult females, was only 2.75 (1-3). An adult female collected 23 January 1998 had five corpora lutea but no embryos. It is possible that she had not yet mated, or that the eggs had only just been fertilized and were not detected during macroscopic examination of her oviducts.

Based on numbers of corpora lutea, placental scars, or embryos, most North American beaver populations have mean litter sizes of 3-4, and a range of 1-9 young (Bradt 1938, Brenner 1964, Grasse and Putnam 1950, Hay 1957, Henry and Bookhout 1969, Hodgdon 1949, Leege and Williams 1967, Miller 1948, Osborn 1953, Payne 1984, Wigley et al. 1983). Litter size is positively correlated with female body weight (Pearson 1960), but does not necessarily increase with age. It is probably more correlated with the quality and quantity of winter food supplies and severity of the winter weather (Jenkins and Busher 1979).

Mean fertility rate (total # embryos/total # corpora lutea) for females with embryos was 60.54% (25-100). Although 12 corpora lutea were present on the right ovaries, the right uterine horns contained only four embryos (33% fertility rate). The left ovaries, however, had seven corpora lutea and the left uterine horns had seven embryos (100% fertility rate).

Embryo length ranged from 1-2 mm in late January to 6-7 mm in early March. This roughly translates to an embryonic growth rate of 5mm/month during the early stages of development. The gestation period at Quantico Marine Base is most likely 120 days, with parturition in mid- to late May (Bradt 1939, Grasse and Putnam 1950).

Health

Health data for the seven dissected females are presented in Table 2. Five of the seven dissected females had prime pelts, one an average pelt, and one a poor quality pelt with several wounds. Quantity of subcutaneous fat was moderate to high in all specimens. Four females contained moderate mesenteric fat deposits, while three had low to no mesenteric fat. Fat deposits at the base of the tail were moderate to high in all seven females. Overall, fat reserves were judged to be moderate to high. Four females had suffered wounds on the body and/or tail, possibly from amorous males.

Table 2. Health data for seven female beavers collected at Quantico Marine Base, Virginia.

Collection Date	Weight (lbs.)	Pelt Condition	Tail Damage	Fat Reserves	Nematodes	Trematodes
1/23/98	53	Average	Yes	Moderate-High	19	24
1/25/98	57	Prime	No	Moderate-High	27	0
2/10/98	51	Prime	Yes	Low-Moderate	1	46
2/15/98	42	Prime	No	Moderate-High	112	26
3/1/98	39	Prime	Yes	Moderate-High	31	16
3/1/98	18	Prime	No	Moderate-High	76	36
4/26/98	21	Poor	Yes	Moderate	354	19

The beavers harbored two species of helminths, the stomach nematode, *Travassosius americanus* (Chapin 1925), and the cecal trematode, *Stichorchis subtriquetrus* (Chapin 1925). Both are common, widespread parasites of beavers (Babero 1953, Bennet and Humes 1939, Brenner 1970, Erickson 1944). No helminths were found in the heart, lungs, liver, kidneys, or bladder.

Travassosius americanus was found in 100% of the females examined. Host incidence of this stomach nematode is often high. Erickson (1944) reported that 124 of 140 (88.6%) Minnesota beavers

harbored this worm, and Babero (1953) found it in 34 of 56 (60.7%) Alaskan beavers. The Quantico beavers averaged 88.6 (1-354; S.D. 122.9) *T. americanus* per individual. All but one of these (found in duodenum) were found in the stomach. Erickson (1944) reported an average of 142 *T. americanus* per beaver in Minnesota with a maximum of 1197, and Babero (1953) also found infestations of over 1,000 worms in Alaskan beavers. The maximum number of stomach nematodes in Pennsylvania beavers was 225 (Brenner 1970).

Stichorchis subtriquetrus was found in all but one (86%) of the Quantico females. Quantico beavers averaged 23.9 (0-46; S.D. 14.7) trematodes per individual. All of these were found in the cecum. Erickson (1944) recovered cecal trematodes from 110 of 140 (78.6%) Minnesota beavers, but Babero (1953) found the worm in only eight of 56 (14.0%) Alaskan beavers. Brenner (1970) reported a maximum of 65 cecal trematodes from Pennsylvania beavers.

The beaver population at Quantico Marine Base is reproductively similar to healthy populations throughout North America, and despite their moderate worm burden, Quantico beavers appear to be of average to above average health. Given these factors, beaver populations should continue to thrive in northern Virginia as long as suitable habitat is available.

Acknowledgements

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Thomas Milton Oler, Jr.

Haven Kolb

When Thomas Milton Oler, Jr., died on June 14, 1999 his period of membership in the Natural History Society of Maryland (NHSM) was the longest of any of our present members. Although he was not one of the founders, he joined the organization in 1934, just five years after its inception. Thus, his membership endured for 65 years. And that membership, throughout its many years, was a very active one. The few of us remaining who can recall those early years- the 1930's- remember that at the time there were two other Olers also active in the NHSM: Milton's father, also Milton, but usually distinguished as "Pop", and his son, Douglas, a member of the "Junior Division", then a flourishing group.

At that time many of the adult members had some special interest within the general field of natural history and this was recognized by the organization of departments. However, they were rather loosely constituted and it was not required that each member belong to one. Milton became a member of the Department of Archeology, probably because of his strong interest in the artifacts of Maryland Indians, and for many years served as its Assistant Curator. However, this was but one facet of a personal characteristic that was both wider and deeper: an intense interest in all the possibilities that lie in the shaping of materials combined with the manual dexterity and the intellectual insight to produce beautiful and meaningful objects. The ramification of this outstanding characteristic of Milton's persona was basic to the long decades of his service to the NHSM.

That service began rather soon after he became a member. When in 1936 the Natural History Society took on the task of making a real museum, even though a modest one, out of the old 1876 vintage Maryland House in Druid Hill Park, Milton's vision and skills became the principal resources on which the completion of that undertaking depended. He served as Curator of the Museum from its very beginning, and oversaw the development and management of the entire facility.

Two particularly memorable features of that work may be recalled here. The one of largest scale was the whale skeleton. In the late nineteenth century a young baleen whale had become stranded in the Chesapeake Bay and died. Through the interest of some Baltimore citizens the carcass was defleshed and the skeleton salvaged. Milton assembled the old bones, produced plaster casts for missing sections, and mounted the skeleton in natural form in the large central hall of the Maryland House, where it remained a popular exhibit until the museum was closed in

The second memorable feature was at the opposite scale: a series of miniature dioramas depicting various natural Maryland habitats of the present, and from the geological past. No one who saw these exhibits in their nearly forty years of display could fail to recognize the thought in their design and the skill in their construction.

But time and circumstances brought forth another area of service. With the death of Edmund B. Fladung, Sr., in 1956 it became necessary to distribute that founder's multitudinous functions among other NHSM members. Eventually, the post of treasurer fell to Milton and for many years he provided the Board of Trustees with a continuous detailed accounting of the status of its monies. In 1993 the NHSM decided to acknowledge local naturalists who exemplified the goals of the Society with its annual Fladung Awards, named after its founder. Milton was among the first recipients of that honor.

This notice of the passing of Milton Oler, Jr. is, because of its place of publication, necessarily biased toward the NHSM. It should not close, however, without some reference to other matters. His interests and

skills in the shaping of materials applied to all aspects of his life. For example, he was much involved in model railroading. Another characteristic- this one not previously mentioned- was his devotion to his family. And perhaps related to this was his pleasure in conversation and reminiscence, particularly of early twentieth century Baltimore. In his last few years he remained at home in his son's residence where, despite hearing difficulties, his sharp and clear mind continued his pleasure in visitors.

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The Bryoflora of the Great Cypress Swamp Conservation Area, Sussex County, Delaware and Worcester County, Maryland

William A. McAvoy

Introduction

In 1998 the Delaware Natural Heritage Program (DNHP), with funding from the U.S. Environmental Protection Agency, completed a biological/ecological survey of the Great Cypress Swamp Conservation Area (GCSCA). The GCSCA is located in the central portion of the Delmarva Peninsula (a land area composed of the coastal plain counties of Delaware and the eastern shore counties of Maryland and Virginia) and lies on the border of Sussex County, Delaware and Worcester County, Maryland (Figure 1). Though the survey included a variety of inventories (avian, amphibian and reptile, natural community, and rare vascular plants), it is the data collected on bryophytes (mosses and liverworts) that are reported here.

The study of bryophytes on the Delmarva Peninsula has attracted very little interest over the years, and a search of the literature revealed only four pertinent papers. Owens (1949), while studying at the University of Maryland, submitted a graduate thesis titled *A Preliminary List of Maryland Mosses and their Distribution.* This annotated list, containing county distribution data and brief habitat notes, included 198 taxa of mosses for the state of Maryland, with 65 taxa attributed to the eastern shore counties of Delmarva. Owens's list was based solely on pre-1949 collections at US and MARY (Herbaria acronyms follow Holmgren et al. 1990). Confirmations and determinations were made by the author, as well as by numerous other authorities in the field of bryology (Owens 1949). Owens pointed out that "few, if any, specimens have been collected in certain distinctive areas, such as: the fresh marshes, the cypress swamps, and the dune areas of the coastal plain." It is assumed that this statement, at least in part, referred to Delmarva habitat on the eastern shore of the state. Davis (1976) composed an unpublished report at Salisbury State University titled *A Survey of the Bryophytes of Wicomico County, Maryland.* Davis listed 51 species of bryophytes (41 mosses and 10 liverworts) based on a single season of field work within 18 acres near his home, and at "a dozen other areas of the county" where "spot checks" were done. Specimens were verified by Dr. R. Pursell, Pennsylvania State University (Davis 1976). Both Owens's and Davis's work emphasized the limited amount of bryological study that has been done in Maryland, and the lack of publications on the subject (Owens 1949, Davis 1976).

Allen (1990) published a checklist of the mosses of Delaware containing 140 taxa. Allen's list was based on personal collections, and collections at DUKE, MO, NY, PAC, PH, and REED. Allen's list indicated that less than 200 specimens of mosses, including his own, were available from Delaware, with the majority made in the late 1800's by Albert Commons (Allen 1990). Karlin et al. (1991) published on the sphagnum flora of Delaware based on personal collections made during "numerous forays" to the state, and on collections from BING, DOV, DUKE, MARY, MO, NY, PH, REED, and US. Karlin noted that "almost all collections of sphagnum in Delaware have been made since 1960. Less than two dozen collections predating 1960 were observed and all of these were made by A. Commons and William Canby in the late 1800's." Karlin reported 21 species of sphagnum for Delaware, 12 of which were new to the state based on his collections. In contrast, Allen (1990) listed only 9 species of sphagnum for Delaware. Regarding hepatics (leafy and thalloid liverworts) on Delmarva, only Davis's (1976) report includes this group, with 10 taxa being listed. Herbaria studies by this author for both mosses and hepatics in Delaware and on the Delmarva Peninsula have not yet been completed, but initial searches, with a focus on hepatics, have revealed very few collections. The majority of those collections were made in the late 1800's by Albert Commons.

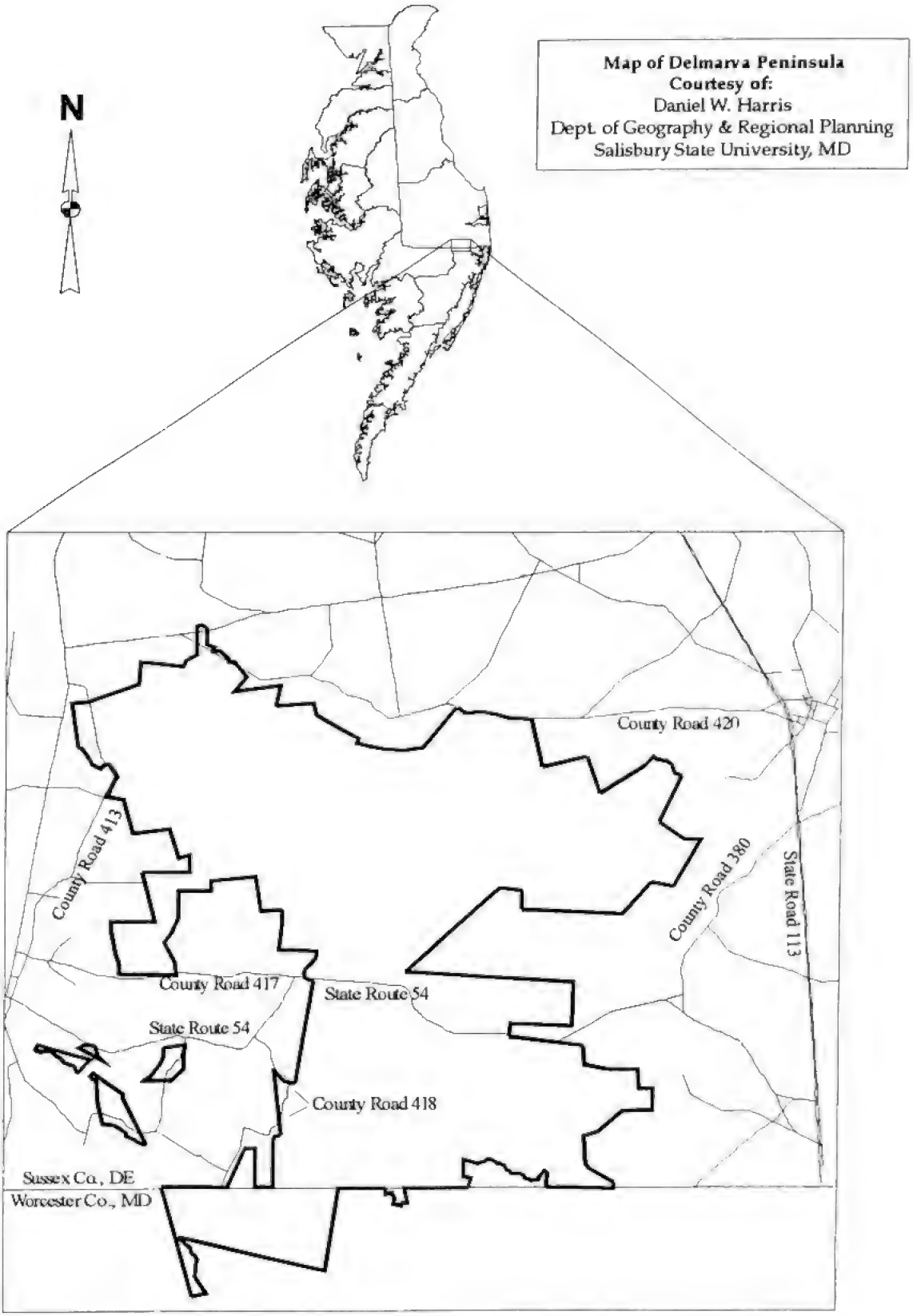

Figure 1. Location of the Great Cypress Swamp Conservation Area, Sussex County, Delaware and Worcester County, Maryland. Map of Delmarva Peninsula courtesy of Daniel W. Harris, Department of Geography & Regional Planning, Salisbury State University.

This survey of the GCSCA marks the first study of bryophytes in Delaware and on the Delmarva Peninsula since the work of Allen (1990) and Karlin (1991). Furthermore, collections of bryophytes from the GCSCA will be the first entries into a database that the DNHP is developing on the bryoflora of Delaware. This database will aid in efforts to conserve the floristic diversity of the region.

Site Description

The majority of the GCSCA lies within the headwaters of the Pocomoke River, which originates in Sussex Co., Delaware, flows through Worcester and Somerset Counties, Maryland and empties into the Chesapeake Bay. Originally, the swamp covered an estimated 20,000 ha, but due to timber harvesting, clearing for agriculture, ditching and draining, and two devastating fires that took place in 1782 and 1931 (Anonymous 1797, Higgins 1932) the swamp has been reduced to its present size. The GCSCA is the largest block of forest remaining on the Delmarva Peninsula and is estimated to include 5,000 ha (ca. 4,400 ha in Delaware and ca. 600 ha in Maryland). Four thousand (4,000) hectares are owned by Delaware Wild Lands Incorporated, a private conservation group.

Prior to disturbances, the GCSCA was largely composed of Atlantic white cedar, *Chamaecyparis thyoides*, and bald cypress, *Taxodium distichum* (Anonymous 1797, Tatnall 1939). Presently, only small remnant populations of Atlantic white cedar and bald cypress remain in the GCSCA. Today, the swamp is composed of a mosaic of seasonally flooded to poorly drained, mesic to dry habitat types. In general, the canopy is composed of a mix of deciduous species, red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), swamp black gum (*Nyssa biflora*), American holly (*Ilex opaca*) and loblolly pine (*Pinus taeda*). Common species in the shrub layer include, highbush blueberry (*Vaccinium corymbosum*), sweet pepper bush (*Clethra alnifolia*), sweet leaf (*Symplocos tinctoria*), and sweet bay magnolia (*Magnolia virginiana*). The often sparse herb layer contains Virginia chain fern (*Woodwardia virginica*), Walter's sedge (*Carex striata*), and wood fern (*Dryopteris intermedia*).

Methods

Bryophyte surveys were conducted from June to September 1998, and were done entirely within the boundaries of the property owned by Delaware Wild Lands in Sussex County, Delaware, and Worcester County, Maryland. Surveys were conducted along trails leading to permanent survey points originally established by the DNHP from 1996-98 for the purpose of conducting biological inventories of the swamp (Bennett et al. 1999). These survey points were established to facilitate repeatability of future surveys and to allow for direct comparison with future data for long-term monitoring of the GCSCA. Trails to the points were established to aid in access to more remote areas of the swamp. Because these trails were used as a sampling unit in this survey, they will hereafter be referred to as "transects" or "transect lines." Surveys and collections were made along 53 transect lines and at 76 survey points.

Survey points were placed throughout the swamp in order to capture the variety of different natural community types found in the swamp. At several locations in the swamp, transects connected more than one survey point. Points that were positioned along the same transect line were about 200 m apart. Points were mapped using a Corvallis Global Positioning System unit. To increase the accuracy of this data, Corvallis Personal Computer-Global Positioning System software was used to perform differential corrections on the location data collected in the field. These data were downloaded to GIS and the transect lines were drawn on the same coverage. The length of each transect was determined by the GIS program. Overall, transect lines covered about 11,755 m. The average length of transect lines was approximately 220 m; the longest line was 910 m and the shortest line was 35 m.

Surveys consisted of walking transect lines and recording the presence of each bryophyte species encountered within approximately 5 m of either side of the line and within a 50 m radius of each survey point. If a species was present along a transect or near a point, it was recorded only once. No attempt was made to determine the abundance of each species along transects, or to distinguish between observations made along transect lines versus survey points. Relative frequency of occurrence (i.e., percentage of transects where each species was observed) was determined for each species encountered.

Results and Discussion

Bryophytes were identified in the laboratory from voucher specimens made during surveys. A large number of duplicate collections and observations were made, suggesting that an appropriate level of sampling was done to document the bryoflora of the swamp thoroughly. Determinations were made by the author with the exception of *Cryphaea glomerata*, which was determined by Dr. Norton G. Miller of the New York State Museum. Dr. Miller also confirmed the identifications of *Forsstroemia trichomitria, Isopterygium tenerum*, and *Steerecleus serrulatus*. At least one voucher specimen was made by the author for all bryophyte taxa encountered. Voucher specimens are currently housed in the reference herbarium of the DNHP, and duplicate specimens of *Cryphaea glomerata, Forsstroemia trichomitria, Isopterygium tenerum*, and *Steerecleus serrulatus* are deposited at the New York State Museum, Albany, New York (NYS). Nomenclature for mosses follows Anderson, Crum, and Buck (1990). Nomenclature for sphagnum follows Anderson (1990). Nomenclature for hepatics follows Stotler and Crandall-Stotler (1977). Distributional data for mosses are based on Crum and Anderson (1981), sphagnum on Crum and Anderson (1981) and Karlin et al. (1991), and hepatics on Ireland and Bellolio-Trucco (1987) and Redfearn (1979).

A total of 50 species and varieties of mosses (37) and liverworts (13) were documented during this survey of the GCSCA. These include 30 taxa of mosses (Class Bryopsida), 7 taxa of peat mosses (Class Sphagnopsida), 2 taxa of thalloid liverworts (Class Hepaticopsida,Order Metzgeriales), and 11 taxa of the leafy liverworts (Class Hepaticopsida, Order Jungermanniales). A total of 20 families are represented within Subdivision Musci (includes both the true mosses and the peat mosses) and a total of 9 families within Subdivision Hepaticae (includes both the thalloid and leafy liverworts). Twenty-seven genera are found within Subdivision Musci, and 10 genera within Subdivision Hepaticae. Table 1 contains a list of taxa arranged taxonomically and in alphabetical order, with brief habitat notes.

Table 1. Bryophytes of the Great Cypress Swamp Conservation Area, Sussex County, Delaware and Worcester County, Maryland.

SUBDIVISION – MUSCI (Mosses)	
Class – Bryopsida (True Mosses)	**Habitat**
AMBLYSTEGIACEAE	
Amblystegium varium (Hedw.) Lindb.	Bases of trees
ANOMODONTACEAE	
Anomodon attenuatus (Hedw.) Hub.	Trunks and bases of trees
AULACOMNIACEAE	
Aulacomnium palustre (Hedw.) Schwaerg.	Decomposing logs and stumps; bases of trees
BRACHYTHECIACEAE	
Bryoandersonia illecebra (Hedw.) Robins.	Bases of trees
Steerecleus serrulatus (Hedw.) Robins.	Decomposing logs and stumps; bases of trees
CLIMACIACEAE	
Climacium americanum Brid.	Bases of trees above water line

Table 1. Continued.

CRYPHAEACEAE	
Cryphaea glomerata Bruch & Schimp. *ex* Sull.	Trunks of trees
DICRANACEAE	
Dicranum flagellare Hedw.	Decomposing logs and stumps; bases of trees
D. scoparium Hedw.	Moist to well drained soils
ENTODONTACEAE	
Entodon seductrix (Hedw.) C. Mull.	Decomposing logs and stumps; bases of trees
FISSIDENTACEAE	
Fissidens dubius P. Beauv.	Bases of trees
HYPNACEAE	
Hypnum imponens Hedw.	Decomposing logs and stumps; bases of trees
Isopterygium tenerum (Sw.) Mitt.	Decomposing logs and stumps
Platydictya subtilis (Hedw.) Crum	Decomposing logs and stumps
Platygyrium repens (Brid.) Schimp. *in* B.S.G.	Decomposing logs and stumps
Pylaisella selwynii (Kindb.) Crum, Steere & Anders.	Trunks of trees
LEPTODONTACEAE	
Forsstroemia trichomitria (Hedw.) Lindb.	Trunks of trees
LEUCOBRYACEAE	
Leucobryum albidum (Brid. *ex* P. Beauv.) Lindb.	Moist to well drained soils; logs and stumps
MNIACEAE	
Mnium hornum Hedw.	Moist soil
M. stellare Hedw.	Bases of trees
Plagiomnium cuspidatum (Hedw.) T. Kop	Moist soil; bases of trees
ORTHOTRICHACEAE	
Orthotrichum ohioense Sull. & Lesq. *in* Aust.	Trunks of sweet gums (*Liquidambar styraciflua*)
POLYTRICHACEAE	
Atrichum angustatum (Brid.) Bruch & Schimp. *in* B.S.G.	Moist sandy soil
Polytrichum commune Hedw. var. *commune*	Moist to well drained soil
P. commune Hedw. var. *perigoniale* (Michx.) Hampe	Moist to well drained soil
P. ohioense Ren. & Card.	Moist to well drained soil
SEMATOPHYLLACEAE	
Sematophyllum adnatum (Michx.) E.G. Britt.	Trunks of trees
TETRAPHIDACEAE	
Tetraphis pellucida Hedw.	Decomposing logs and stumps; bases of trees
THELIACEAE	
Thelia hirtella (Hedw.) Sull. *in* Sull. & Lesq.	Trunks and bases of trees
THUIDIACEAE	
Thuidium delicatulum (Hedw.) Schimp. *in* B.S.G.	Decomposing logs and stumps; bases of trees
Class – Sphagnopsida (Peat Mosses)	
SPHAGNACEAE	
Section Acutifolia	
Sphagnum bartlettianum Warnst.	Low, wet depressions or swales
Section Cuspidata	
Sphagnum cuspidatum Ehrh. *ex* Hoffm.	Low, wet depressions or swales
Section Sphagnum	
Sphagnum affine Ren. & Card.	"banks of roadside ditches" (Karlin et al. 1991)
S. magellanicum Brid.	Moist, sandy soil
S. palustre L.	Edge of low, wet depressions or swales
S. perichaetiale Hampe	Moist, sandy soil
Section Rigida	
Sphagnum strictum Sull.	Moist, sandy soil
Section Subsecunda	
Sphagnum lescurii Sull. *in* Gray	Wet ground along roadside

SUBDIVISION – HEPATICAE (Liverworts & Hornworts)	
Class – Hepaticopsida (Liverworts)	
Order – Metzgeriales (Thalloid Liverworts)	
ANEURACEAE	
Aneura pinguis (L.) Dum.	Wet, decomposing logs and stumps
PALLAVICINIACEAE	
Pallavacinia lyellii (Hook.) Carruth.	Wet, decomposing logs and stumps
Order – Jungermanniales (Leafy Liverworts)	
ADELANTHACEAE	
Odontoschisma denudatum (Mart.) Dum.	Wet, decomposing logs and stumps
O. prostratum (Sw.) Trev.	Wet, decomposing logs and stumps
CEPHALOZIACEAE	
Cephalozia bicuspidata (L.) Dum.	Wet, decomposing logs and stumps
C. connivens (Dicks.) Linb.	Wet, decomposing logs and stumps
Nowellia curvifolia (Dicks.) Mitt.	Wet, decomposing logs and stumps
JUBULACEAE	
Frullania eboracensis Gottsche	Trunks of American holly (*Ilex opaca*)
F. tamarisci (L.) Dum. var. *asagrayana* (Mont.) Hatt.	Trunks of American holly
LEJEUNEACEAE	
Leucolejeunea clypeata (Schwein.) Evans	Decomposing logs and stumps; bases of trees
LEPIDOZIACEAE	
Bazzania trilobata (L.) S. Gray	Decomposing logs and stumps
LOPHOCOLEACEAE	
Lophocolea heterophylla (Schrad.) Dum.	Wet, decomposing logs and stumps
PORELLACEAE	
Porella platyphylloidea (Schwein.) Lind	Trunks of trees

Karlin (1991) listed two species of sphagnum from the GCSCA (*Sphagnum affine* and *S. lescurii*) that "commonly occur on the banks of road side ditches, along the sides of Road 418." Because transect lines and survey points were not placed along roadsides and edges, these two species were not observed during this survey and are not included in data analysis. However, they do appear in the full list of taxa as part of the bryoflora of the GCSCA. An effort was made during this survey to confirm these reports, but only *S. lescurii* was relocated.

Four species of bryophytes documented from the Delaware portion of the GCSCA were not listed by Allen (1990) and Karlin et al. (1991), and are reported here as new records for the state of Delaware: *Fissidens dubius, Platydictya subtilis, Mnium stellare*, and *Sphagnum strictum*. A search of the literature dealing with bryological studies in Maryland focused only on studies that included, or were restricted to the eastern shore counties of the state. As a result, state record determinations cannot be made within the context of this paper.

Bryophytes considered to be common in the swamp were encountered on 50% or more of the transect lines and survey points. They include the following (Table 2 contains a complete list of taxa with the relative frequency of occurrence for each): *Leucobryum albidum* 89%, *Sematophyllum adnatum* 76%, *Dicranum flagellare* 70%, *Thelia hirtella* 70%, *Thuidium delicatulum* 66%, *Lophocolea heterophylla* 64%, *Odontoschisma prostratum* 64%, *Steerecleus serrulatus* 62%, and *Sphagnum cuspidatum* 57%.

Table 2. Relative frequency of occurrence of bryophytes along transect lines and survey points in the Great Cypress Swamp Conservation Area, Sussex County, Delaware and Worcester County, Maryland.

Scientific Name	Frequency (%)
Leucobryum albidum	89
Sematophyllum adnatum	76
Dicranum flagellare	70
Thelia hirtella	70
Thuidium delicatulum	66
Lophocolea heterophylla	64
Odontoschisma prostratum	64
Steerecleus serrulatus	62
Sphagnum cuspidatum	57
Cephalozia connivens	49
Dicranum scoparium	47
Frullania eboracensis	47
Aulacomnium palustre	45
Odontoschisma denudatum	41
Hypnum imponens	40
Sphagnum palustre	40
Anomodon attenuatus	30
Frullania tamarisci var. *asagrayana*	28
Leucolejeunea clypeata	28
Pallavacinia lyellii	28
Isopterygium tenerum	23
Nowellia curvifolia	20
Polytrichum commune var. *commune*	20
Tetraphis pellucida	17
Mnium hornum	15
Mnium stellare	15
Platygyrium repens	13
Polytrichum ohioense	13
Orthotrichum ohioense	9
Atrichum angustatum	8
Forsstroemia trichomitria	8
Plagiomnium cuspidatum	8
Sphagnum perichaetiale	8
Polytrichum commune var. *perigoniale*	6
Bazzania trilobata	4
Bryoandersonia illecebra	4
Cephalozia bicuspidata	4
Climacium americanum	4
Entodon seductrix	4
Platydictya subtilis	4
Pylaisella selwynii	4
Sphagnum magellanicum	4
Amblystegium varium	2
Aneura pinguis	2
Cryphaea glomerata	2
Fissidens dubius	2
Porella platyphylloidea	2
Sphagnum bartlettianum	2
Sphagnum strictum	2

Seven species of bryophytes were observed or collected on only one transect line or survey point: *Amblystegium varium, Aneura pinguis, Cryphaea glomerata, Fissidens dubius, Porella platyphylloidea, Sphagnum bartlettianum,* and *S. strictum*. *Porella platyphylloidea* was collected from the portion of the swamp that lies within Worcester County, Maryland, the remaining six were all collected from the Sussex County, Delaware side of the swamp. The low frequency of these seven taxa indicate that they may be of conservation concern. Further studies of the bryoflora of Delaware and Maryland are needed before the status of these species can be determined.

Comparing overall plant species diversity of the GCSCA, 155 species and varieties of vascular plants (Bennett et al. 1999) were documented from the swamp during this survey versus 50 species of bryophytes.

Of the 50 species and varieties of bryophytes documented during this survey of the GCSCA, three species have a southern distribution and are in the GCSCA near their northern limit of geographical distribution in eastern North America. These include *Cryphaea glomerata* (New Jersey south to Florida and Texas), *Sphagnum bartlettianum* (along the coast from Maryland south to Florida, reported from New Jersey), *Sphagnum strictum* (coastal plain of New Jersey south to Florida, and west to Louisiana). One species, *Platydictya subtilis*, has a northern distribution and occurs in the GCSCA near its southern coastal plain limit in eastern North America (Nova Scotia south to New York and Michigan, and in the mountains of North Carolina). The remaining 46 species of bryophytes from the GCSCA are generally widespread in eastern North America.

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I am especially grateful to Dr. Norton Miller for his teaching and guidance, for his valuable time spent in identifying and confirming difficult taxa, and for his review of this manuscript. I would also like to give very special thanks to Karen Bennett for assistance in data analysis and interpretation, help in navigating through computer software programs, and for her insightful and valuable comments while reviewing this manuscript. Acknowledgment is also given to Lynn Broaddus, Kitt Heckscher and Art Tucker for helpful editorial comments and suggestions. Many thanks also to Eric Zuelke for his efforts in the creation of maps and figures, and to Patricia McAvoy and Lynn Davidson for their help in obtaining obscure literature sources. This project was supported by funding from the U. S. Environmental Protection Agency.

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Flood Induced Winter Mortality of Wood Turtles (*Clemmys insculpta* Le Conte) in Maryland

Arnold W. Norden

According to current information (Harding 1991, 1995; RESTORE et al 1994) *Clemmys insculpta* is a slow growing and long-lived species exhibiting low levels of juvenile recruitment, which leads to a population structure biased toward older adults. The mortality of eggs and hatchlings may be as high as 98%, but adult turtles are fairly secure from predation. In addition, the wood turtle seems to be relatively resistant to low levels of rural development (non-intensive agricultural use, grazing, modest timber harvesting, low density riparian development and recreation). The greatest threat to *C. insculpta* populations appears to be human activities, such as changes in land use that result in habitat loss, commercial and hobby collecting, and vehicular kills where turtles attempt to cross roadways. Human impact on this species has accelerated in recent years as the desirability of this interesting and attractive turtle has risen in the pet trade, and populations of *C. insculpta* are declining just about everywhere that they have been studied. This note reports two instances of mortality in wood turtles caused by cold season floods.

The first occurrence was reported to me by Jim Davis (*in litt*), a local naturalist. In November of 1992 he was exploring a tributary of Licking Creek (Potomac River drainage) within the Indian Springs Wildlife Management Area in Washington County, Maryland. Despite very cold air (about -6.5° C) and water temperatures, Davis encountered two adult male wood turtles. One turtle was in a very shallow part of the creek, sluggishly moving upstream toward a breached beaver dam. The second turtle was partly submerged beneath a patch of multiflora rose in a marshy area along the bank. Both turtles were brought home and placed in cool water that was allowed to warm to room temperature. The first turtle responded well to this treatment, while the condition of the second turtle deteriorated and it died two days later. The surviving turtle was taken to the Piney Branch Nature Center to be kept over the winter, and was released near the point of capture the following spring. Davis felt that these turtles had been hibernating in the beaver pond and were probably washed downstream when the dam was breached.

The second occurrence, and one involving a greater number of turtles, was reported to me by Mike Dean, a biologist with the Maryland Department of Natural Resources, Fisheries Administration. In January of 1996, strong rains and rapid melting of over 1.3 m of snow caused major flooding throughout western Maryland. Along Fifteen Mile Creek (Potomac River drainage) at Yonkers Bottom in Allegany County, Dean observed about forty turtles on land along the floodplain. All were adults, and most were wood turtles, although a few painted turtles were also present. Even though the air temperature was below freezing, the turtles were alive and able to respond to touch. Obviously, these turtles had recently been washed from hibernacula in the creek's deeper pools by flood waters and left exposed on the floodplain.

In both of these instances, adult wood turtles appear to have been washed from hibernacula and deposited in locations where they would not have been able to survive the winter. I would not expect that the occasional loss of a few adult males (as in the Licking Creek event) would significantly impact an otherwise healthy colony of *C. insculpta*. However, the loss of more that 30 adults from one stream system, as occurred at Fifteen Mile Creek, is of considerable significance. Although floods are natural occurrences, human induced changes in land use do increase the magnitude and frequency of flood events, adding additional stress to populations of *Clemmys insculpta*. Even though little can be done to eliminate flooding, management of important wood turtle habitat should include measures to minimize increases in runoff volume. In addition, mortality of adult wood turtles could be minimized if areas downstream of known or potential hibernacula were be examined immediately following periods of high water or flooding that occur during the cold periods of the year.

I thank Mike Dean and Jim Davis for reporting their observations to me. James Harding (Michigan State University Museum) and Michael Amaral (U.S. Fish and Wildlife Service) discussed with me the biology and status of *C. insculpta*. Also, Dave Lee (The Tortoise Reserve) and William Grogan (Salisbury State University) read and commented on a earlier draft of this note. Their assistance is much appreciated.

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Land Snails of Black Hill Regional Park, Montgomery County, Maryland

Aydin Örstan

Abstract.- Twenty four land snail species were found in Black Hill Regional Park in Montgomery County, Maryland. Records of *Euconulus dentatus*, *Glyphyalinia rhoadsi*, *Hawaiia minuscula*, *Nesovitrea electrina*, *Striatura meridionalis*, *Strobilops labyrinthica*, *Succinea ovalis* and *Vertigo gouldi* are the first for the county.

Introduction

According to the distribution maps in Hubricht (1985), 27 species of native land snails (excluding slugs) have been recorded from Montgomery County, Maryland. Those maps were based primarily on Hubricht's own records and the records in Pilsbry (1939-1948), supplemented by records in several other publications. The most recent land snail records from Montgomery County are those in Grimm (1971). Considering the rapid development the area has undergone in recent years resulting in the loss of forests where most of these snail species live, historic records, especially those in Pilsbry, some of which date to the 19th century, may no longer reflect the actual distribution of land snails in this area.

I summarize here my records of land snails (excluding slugs) collected in Black Hill Regional Park, between December 1997 and May 1999.

Study Site And Methods

Black Hill Regional Park in northern Montgomery County, Maryland (39°12'N, 77°17'W), covers 746 hectares (1843 acres), 204 hectares (505 acres) of which is Little Seneca Lake formed in the late 1980s by damming Little Seneca Creek. On the U.S. Geological Survey's 7.5 minute topographic map of the Germantown Quadrangle (last revised based on aerial photographs taken in 1978), the park is shown as Little Seneca Regional Park. The average elevation within the park is about 140 m. Figure 1 shows the current boundaries of the park (based on a recent trail guide) and the approximate extent of areas within the park that are shown to be wooded on the Geological Survey's map. I searched for snails only in these wooded areas, where most trees are deciduous, specifically under leaf litter along rotting tree trunks and rocks near creeks and on hillsides.

Snails were identified by shell characteristics, but I confirmed the identity of *Neohelix albolabris* by dissection. I confirmed the identifications of *Anguispira fergusoni*, *Euconulus dentata*, *Glyphyalinia indentata*, *Hawaiia minuscula*, *Punctum minutissimum* and *Zonitoides arboreus* by comparing my specimens with those at the Academy of Natural Sciences (ANS), Philadelphia, using the shells in the Academy's lots that had been collected in Washington, D.C. and Maryland. Dr. Timothy Pearce of the Delaware Museum of Natural History also helped with some identifications. The primary references used for identifications were Pilsbry (1939-1948), MacMillan (1949), Emberton (1988) and Burch and Pearce (1990).

Results

The 24 species of land snails identified from the park are listed in Table 1. The general locations where these snails were found are shown in Figure 1. A histogram of the height to diameter ratios of all the species is given in Figure 2. Specific comments about seven of the species are given below.

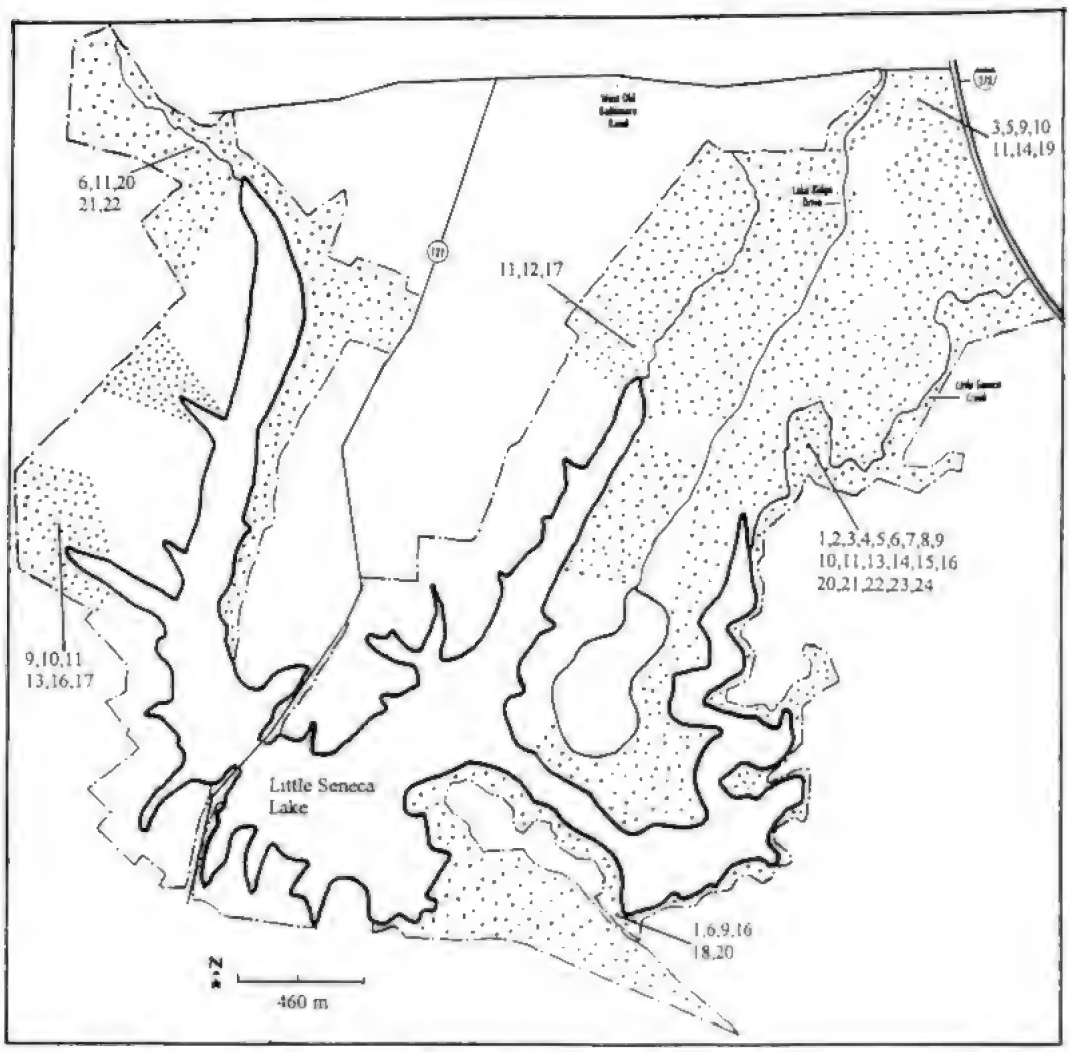

Figure 1. Distribution of land snails in Black Hill Regional Park, Montgomery County, Maryland. Species numbers correspond to those in Table 1. Stippled areas are woodland, based on the U.S. Geological Survey's 1978 revision of the Germantown Quadrangle map.

Anguispira fergusoni - This species is quite common in the wooded areas along Little Seneca Creek in the northeast section of the park (Fig. 1). Surprisingly, I have not found it elsewhere in the park, except for a few juvenile shells from a location near the southern boundary.

Euconulus dentatus - A single *Euconulus* shell with a damaged lip had a short white radial callus on the base of its last whorl. I identified this specimen as *E. dentatus* based on comparison with ANS specimens of *E. dentatus* from Washington, D.C.

Glyphyalinia indentata ? - I identified a snail relatively common in the park as *Glyphyalinia indentata* based on comparison with material at ANS. However, according to Hubricht (1985), what is now known as *Glyphyalinia indentata* is actually a group of anatomically different species with similar or identical shells. Until anatomical studies are carried out, my identification should be considered tentative.

Mesodon thyroidus - Of the 17 mature shells of this species collected in the park, 10 had a small parietal tooth. Toothed and toothless shells occurred together.

Neohelix albolabris - I dissected one *Neohelix* from the park. The internal (uneverted) anatomy of its penis matched that of *N. albolabris* as figured by Emberton (1988).

Triodopsis fallax - I found one empty shell of this species in a wooded area near the northeast corner of the park. This record is interesting because according to Hubricht (1985) this species lives on open ground, not in woodland. However, the location where I found it had, besides rotting tree trunks, a large concrete pipe and pieces of barbed wire buried under piles of rocks, suggesting that the species may have been introduced to the area as a result of past human activity. Further collecting will be necessary to determine if *T. fallax* is an established resident of the park.

Succinea ovalis ? - I found empty shells of a succineid snail (Succineidae) under leaf litter on a rocky eastern slope of the prominence named Black Hill on the Geological Survey's map, now located in a partially residential area near the southern boundary of the park (Fig. 1). Four succineid species, one *Succinea*, one *Oxyloma* and two *Catinella*, have been recorded from the neighboring counties (Hubricht 1985). I used the key in Burch and Pearce (1990) to assign the shells from the park to *Succinea*. Therefore, I assume that the species in the park is *Succinea ovalis*, previously recorded from Frederick, Howard and Prince George's counties (Grimm 1971, Hubricht 1985). Since dissection is recommended for positive identification of most succineid species (Hubricht 1985, Burch and Pearce 1990), further searches in the area for live specimens will be necessary to confirm this tentative identification.

Table 1. Land snails, excluding slugs, recorded from Black Hill Regional Park, Montgomery County, Maryland. Asterisks indicate new records for Montgomery County. Question marks indicate tentative identifications.

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1. *Anguispira fergusoni* (Bland)
2. *Euconulus dentatus* (Sterki) *
3. *Gastrocopta contracta* (Say)
4. *Gastrocopta pentodon* (Say)
5. *Glyphyalinia indentata* (Say) ?
6. *Glyphyalinia rhoadsi* (Pilsbry) *
7. *Haplotrema concavum* (Say)
8. *Hawaiia minuscula* (A. Binney)*
9. *Helicodiscus parallelus* (Say)
10. *Mesodon thyroidus* (Say)
11. *Neohelix albolabris* (Say)
12. *Nesovitrea electrina* (Gould) *
13. *Punctum minutissimum* (I. Lea)
14. *Stenotrema hirsutum* (Say)
15. *Striatura meridionalis* (Pilsbry & Ferriss) *
16. *Strobilops aenea* Pilsbry
17. *Strobilops labyrinthica* (Say) *
18. *Succinea ovalis* (Say) ? *
19. *Triodopsis fallax* (Say)
20. *Triodopsis juxtidens* (Pilsbry)
21. *Ventridens ligera* (Say)
22. *Ventridens suppressus* (Say)
23. *Vertigo gouldi* (A. Binney) *
24. *Zonitoides arboreus* (Say)

Discussion

The current land snail records from Black Hill Regional Park indicate that what may be the original land snail fauna of the area has fortunately survived, even though the total wooded area in the park is relatively small. As most of these species were found around rotting tree trunks in areas where there was adequate leaf litter to retain moisture, it is important that fallen trees not be removed, but left to rot where they have fallen. Rotting trees are essential parts of a forest ecosystem, providing food and habitat for many organisms besides snails (Maser and Trappe 1984).

The distribution of the height/diameter ratios of the 24 species found at Black Hill Regional Park is bimodal with a major peak at 0.50-0.59 and a minor peak at 1.70-1.79 (Fig. 2). The general locations and relative heights of these peaks are the same as those in the bimodal distributions of height/diameter ratios of the land snails of Pine Mountain, Kentucky (Emberton 1995) and the coastal forests of British Columbia, Canada (Cameron 1988). This suggests that a bimodal distribution of height/diameter ratios with peaks at about 0.50 and 1.70 may be the norm for land snail faunas in North American forest habitats.

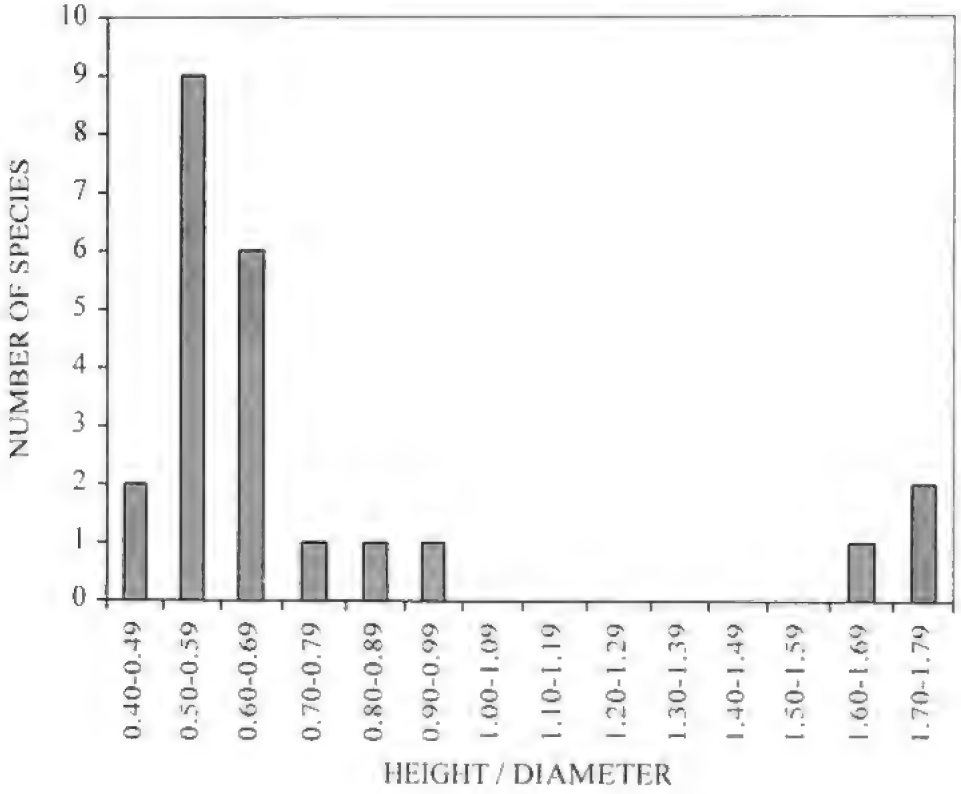

Figure 2. Distribution of the height to diameter ratios of species of land snails from Black Hill Regional Park.

The internal (uneverted) penis anatomy of *Neohelix albolabris* distinguishes it from the conchologically identical *N. solemi* (Emberton 1988). The records verified by dissection in Emberton's compilation suggest that *N. solemi* occupies the eastern Coastal Plain, while *N. albolabris* occurs further to the west. However, the area of contact between these two species west of the Chesapeake Bay has not yet

been identified. My record of *N. albolabris* from Black Hill Regional Park shows that its range extends at least as far east as Montgomery County. A detailed study of the distribution of these two closely related species in Maryland, Virginia and Delaware would be useful in understanding their evolutionary history.

Acknowledgements

I thank Dr. Timothy Pearce of the Delaware Museum of Natural History for helping me identify some of the species, Dr. Gary Rosenberg of the Academy of Natural Sciences in Philadelphia for providing access to the Academy's collections, Jim McMahon (manager of Black Hill Regional Park) for giving me a permit to collect in the park, and my son Erol for finding some of the shells.

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Notes on Terrestrial Isopods (Isopoda: Oniscoiddae) from the Eastern Shore of Virginia

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The Eastern Shore of Virginia is comprised of Northampton and Accamock Counties at the southern tip of the Delmarva Peninsula. It is located between the Atlantic Ocean on the east and the Chesapeake Bay on the west. Most of the area is agricultural, but there are also large areas of woodland, mostly oak with a few stands of pine. Since there appears to be no published information on terrestrial isopods from this area, the following notes should be of interest. I report here specimens collected during a single trip made on 6 June 1989. All collections, with one exception were made in deciduous woodlands. The exception was one collection made along a railroad right-of-way near the village of Chesapeake. No isopods were found in pine woodlands.

Terrestrial isopods are gill breathers and must live in habitat with a high moisture content. Because of this requirement they are seldom active in day light and remain hidden under decaying wood, in humus, or under rocks or organic debris. The thick deciduous humus found in the Eastern Shore woodlands provides food and good habitat for these small invertebrates.

The species of isopods and the number of individuals collected at each locality are given below. All specimens will be deposited in the collection of the Illinois Natural History Survey.

Family Armadillididae

Armadillidium nasatum Budde-Lund
Northampton County- Capeville (5), Kiptopeke (3), Old Town Neck (1).

Armadillidium vulgare (Latreille)
Accamock County- Keller (2); Northampton County- Capeville (8).

Family Oniscidae

Philoscia vittata Say- (This species is also known as *P. muscorum*.)
Accamock County- Keller (2).

Family Porcellionidae

Porcellis scaber Latreille
Accamock County- Acconac (11), Keller (4), Wachaapreague (2); Northampton County- Capeville (9), Cedar Grove (18), Eastville (29), Kiptopeke (9), Old Town Neck (10), Plantation (6), Wilson Neck (1).

To summarize, a total of 107 specimens were collected in the Virginia Counties of the Delmarva Peninsula. Four species representing three genera were found. Their abundance and frequency of occurrence in these collections were as follows: *P. scaber*= 79 individuals (79%), *A. vulgare*= 17 individuals (16%), *A. nasatum*= 2 individuals (2%), and *P. vittata*= 2 individuals (2%).

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A Survey for *Lucanus elaphus* (Fabricius) (Coleoptera: Lucanidae) in Southern Maryland

C. L. Staines

Abstract.- A survey for *Lucanus elaphus* was conducted during June, July, and August 1999 on state and private properties in Calvert, Charles, and St. Mary's Counties. Survey methods included visual surveys, examination of potential breeding areas, black lighting, and head lamping. No *L. elaphus* life stages were found.

The family Lucanidae (Coleoptera) has fascinated naturalists for years. There are 1000-1200 species of stag beetles in the world (Mizunuma and Nagai 1994) with ten genera and 30 species in the United States (Arnett 1965).

The only North American species of the genus *Lucanus* Scopoli is *L. elaphus* Fabricius. The male of this species is from 31-40 mm long (excluding the mandibles) and the female is about 28 mm long. The reported distribution of the species is Alabama, Kentucky, Illinois, southern Indiana, Maryland, North Carolina, Oklahoma, South Carolina, and Virginia (Arnett 1965; Downie & Arnett 1996; Kirk 1969; Löding 1945; Staines 1986, 1994). Ulke (1902) questioned a record from the District of Columbia. Benesh (1960) reported it from the eastern United States and Ontario. Examination of the collections of the Field Museum of Natural History, the Smithsonian Institution, the Natural History Museum (London), and the Manchester Museum plus discussions with curators at various university collections revealed additional records from Arkansas, Florida, Georgia, Kansas, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Pennsylvania, Tennessee, Texas, and West Virginia.

Lucanus elaphus is uncommon. Kirk (1969) mentions it as most rare in his listing from South Carolina. Blatchley (1910) and Brimley (1938) mention that the female is very rare. According to the Maryland Natural Heritage Program (Anonymous 1994) *L. elaphus* is a candidate for the state endangered and threatened species list (S1), and rare but globally secure (G3G5).

There is little published biological information on *L. elaphus*. Arnett (1965) summarized the biology of the family: larvae live in or beneath decaying logs and stumps feeding on juices of wood in various stages of decay; females lay eggs in bark crevices, especially near roots; adults are attracted to lights. Dillon and Dillon (1961) stated that *L. elaphus* is found in oak stumps. Literature and label data from museum records show that adults have been collected from May to November. Ritcher (1966) stated that he could not distinguish between the larvae of *L. elaphus*, *Pseudolucanus capreolus* (L.), *P. mazama* (LeConte), and *P. placidus* (Say).

The European *L. cervus* (L.) has extended larval development (Whitehead 1993) as does the North American *P. placidus* (Milne 1933) and *P. capreolus* (Cosens 1922). Many species breed in decaying stumps and roots of *Quercus* spp. but have also been recorded from *Salix* (Cosens 1922), *Liriodendron tulipfera* L. (Benesh 1942), *Salix* spp., *Malus* sp., *Prunus* spp. (Gordon 1985), and *Populus* (Van Dyke 1926). *Lucanus cervus* larvae feed on the damp, decaying wood of deciduous trees, usually at or below ground level (Hawes 1998). Adult activity in all species studied is from 1200 to 2400 hours with most species active at dusk on warm, still evenings (Bessonnat 1983, Colas 1962, Hawes 1998, Lacroix 1968, Mathieu 1969, Milne 1933). Adults live from 2 to 4 weeks (Lacroix 1968, Mathieu 1969). Colas (1954) found that female *L. tetraodon provincialis* Colas were much less common than the male, as is the female of *L. cervus* (Hawes 1998).

Staines (1986, 1994) recorded adult *L. elaphus* in Maryland from Pocomoke City (Worcester Co.)

and Lexington Park (St. Mary's Co.) collected in July and early August. There is a specimen in the University of Maryland Entomology Department collection from 1898 from Pocomoke City. A specimen from Baltimore in the Natural History Museum (London) has no date of collection.

Brimley (1938) reported *L. elaphus* as statewide in North Carolina. Kirk (1969) found it only on the coastal plain of South Carolina. The records from Minnesota and Ontario indicate that *L. elaphus* can survive into climatic zone 5. All of the Maryland specimens are known from the coastal plain but the species could be more widespread.

Survey Methods

Lucanus elaphus is a woodland species which is attracted to both white and black light. During the two weeks surrounding the new moon in June, July, and August 1999 black lighting was conducted on private and state lands in Calvert, Charles, and St. Mary's counties. Necessary landowner permission and collecting permits were obtained. Survey sites were selected during daylight hours and observation and sampling of stumps and logs was conducted from 1600 hours to dusk. Black lights were placed near hardwood stumps and logs. Depending on the weather conditions, black lights were monitored from dusk until 2300 hours. Two black lights, separated by 300 meters were used each evening.

Results

Surveys were conducted from 15 to 25 June, 7 to 15 July, and 9 to 11 August 1999. Surveyed properties were Calvert Co.: Battle Creek Cypress Swamp and Calvert Cliffs State Park; Charles Co.: Cedarville State Park, Doncaster State Forest, Myrtle Grove Wildlife Management Area, and Smallwood State Park; and St. Mary's Co.: Daniel Capper property, Church Swamp (Dorsey property), The Elms Environmental Education Center, and St. Mary's River State Park. These areas represented various types of woodland: dry mixed pine-hardwood forest, moist hardwood forest, river bottom hardwood forest, spring flooded hardwood forest, cypress swamp, and higher forested areas near a brackish marsh.

No *Lucanus elaphus* nor damage attributed to the species was found during the survey. When shown a picture of *L. elaphus*, some rangers noted that they had seen individuals in the course of their work. Other lucanids- *Ceruchus piceus* Weber, *Dorcus parallelus* Say, and *Pseudolucanus capreolus* as well as *Odontotaenius disjunctus* (Illiger) (Coleoptera: Passalidae) were found.

Discussion

Locating a population of an rare insect is difficult. Clark (1977) found that *L. cervus* had a very localized distribution, even in areas where it occurs it may be abundant every year in one locality yet completely unknown in another part of the same area. The greatest abundance of a species occurs near the center of its range. Population density declines gradually toward most boundaries. This holds for rare species, but since they inhabit only a small proportion of the sites even in the center their distributions, surveys have a larger sampling error (Brown 1984). Since Maryland is near the northeastern edge of the range, this would indicate that populations of *L. elaphus* would be light and scattered in Maryland.

There are several possible explanations for not finding *Lucanus elaphus*. First, I was unable to obtain permission to survey the two privately owned sites in St. Mary's County with historic collection records. This reduced the chances of success of the survey. Second, the temperatures during the black lighting periods were cooler than normal for eleven of the 17 evenings. Cooler temperatures normally result

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in less insect activity. Finally, the survey was started late due to the time required (10 weeks) to obtain the permit from Maryland Department of Natural Resources to work on state lands. This resulted in the initial surveys being started 7 to 10 days late, and out of phase with the new moon which may have reduced the effectiveness of the black lights.

Several biologists I discussed this project with speculated on why *L. elaphus* is so rare. The most common explanation was that there were insufficient stumps and logs for the species to build up large populations, or that the species was a mature, undisturbed woods inhabitant. I feel that neither of these explanations are valid. Herbivores show a significant trend for population density to increase with increasing body size until some "mid-point", then to decline with increasing body size (Blackburn et al.1990). The trend in coleopterous fungivores (which may include *L. elaphus*) is for population density to decrease significantly with increasing body size (Blackburn et al. 1990). Blackburn et al. (1993) do warn that the body size of a species is a poor predictor of species abundance, but is a possible reason for the rareness of *L. elaphus*. The distribution of *L. cervus* in England suggests a close relationship between the distribution of the beetle and soil type (Hawes 1998, Whitehead 1993). The beetle is found in lighter soils. Analysis of *L. elaphus* distribution and soil type may prove interesting.

Lawton (1989) postulated that large-bodied species required a much lower minimum population to maintain a viable population. This appears to hold for *L. elaphus*, since the species is uncommonly observed but has maintained a population in Maryland for over 100 years.

Acknowledgments

I thank Daniel Capper for permission to conduct surveys on his property, Jonathan McKnight (Maryland Natural Heritage Program) for permission to work at Church Swamp, and the staff at Battle Creek Cypress Swamp, Calvert Cliffs State Park, Cedarville State Park, Doncaster State Forest, The Elms Environmental Education Center, Myrtle Grove Wildlife Management Area, St. Mary's River State Park, and Smallwood State Park for their assistance.

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Observations on *Euphoria inda* (L.) (Insecta: Coleoptera: Scarabaeidae)

C. L. Staines and S. L. Staines

Abstract.- *Euphoria inda* (L.) appears to engage in visual as well as audio mimicry of bumblebees. The species also has a potential defensive chemical. Müllerian mimicry is postulated for this complex.

The genus *Euphoria* Burmeister contains 26 species in America north of Mexico (Arnett 1973) four of which occur in Maryland (Staines 1986). Species are generally large (9 to 18 mm) and slow flying. Adults of some species are common on flowers while others are found feeding on ripe or rotting fruit. Adults have the elytron fused and only use the membranous hind wings in flight (Silberglied and Eisner 1969).

Euphoria inda (L.) is found from Ontario to Florida and west to British Columbia, Washington, and Oregon and south to Arizona (Hatch 1971, Downie and Arnett 1996), and is widespread in Maryland (Staines 1986). Adults are attracted to flowers, fermenting fruit, and vegetable material and occasionally cause damage to field or fruit crops (Blatchley 1910, Hatch 1971, Lago et al. 1979). Adults are attracted to fermenting sugar baits but not to lights. Larvae breed in rich soil, dung, rotten wood, and humus (Ritcher 1966). Schwarz (1890), Wheeler (1910), Ratcliffe (1976), and Lago et al. (1979) found larvae in the nests of different *Formica* spp. (Hymenoptera: Formicidae). The species is univoltine with adults overwintering and becoming active on the first warm, sunny days of spring. In Wisconsin pupation occurs in July and the oval pupal chamber is 2 to 5 inches below the surface (Ritcher 1966). Ritcher (1966) described and illustrated the larva. Adults fly close to the ground with a loud buzzing noise similar to bumble bees (Hymenoptera: Apidae: Bombinae). Specimens are often mistaken for bumble bees. When captured they emit a strong, pungent chemical with a chlorine-like odor.

Observations

On 07 April 1998 two populations of 30+ individuals of *E. inda* were observed on the high western knob of Plummers Island, Montgomery County, Maryland, between 1230 and 1330 hours. The day was sunny with the temperature at about 65°F. Both populations were in wooded areas with *Carpinus* sp., *Carya* sp., *Cercis canadensis* L., *Quercus* spp., *Rhus* sp., *Acer rubrum* L., and *A. negundo* L. as the dominate trees. Leaf expansion was to the point of a 10% canopy cover. Ground vegetation consisted of various Poaceae, *Vaccinum* spp., *Claytonia virginica* L., and *Erythronium americanum* Ker. The coarse humus was settled between rock outcrops.

Euphoria inda adults were flying from 2.5 to 5 cm above the leaf litter always remaining in the sun, keeping to a small area so that all activity was quite noticeable. With the fused elytron the beetles did resemble bumble bees or large tachinid flies (Diptera) in flight.

Discussion

Mimicry of bumble bees is well documented (Brower et al. 1960). Vertebrate predators avoid bumble bees due to the painful and toxic sting. A less well known mimic technique is audio mimicry where the mimic emits wing tones similar to the model (Gaul 1952). *Euphoria inda* appears to use both of these techniques, plus may have its own defensive chemical in the chlorine-like odor given off by captured adults.

Because distastefulness is a relative and variable characteristic (Turner 1984), it is impossible to positively categorize mimetic relationships as Müllerian or Batesian (Huheey 1976). However, this case

seems to be Müllerian mimicry since two distasteful taxa share a common color pattern which maximizes the effect by minimizing the number of patterns predators must remember.

The flight pattern of *E. inda* mimics tachnid flies searching from prey or bumblebees searching for flowers or nesting sites. Often Müllerian mimicry is not close between mimic and model, but in this case they are extremely close.

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THE MARYLAND NATURALIST'S BOOKSHELF- BOOK REVIEW

Venomous Reptiles of North America by Carl H. Ernst. 1992. Smithsonian Institution Press, Washington, D.C, and London. 236 pages. Hardcover $35.00, Softcover $29.95.

In addition to a steady stream of research papers, Carl Ernst has managed to produce a number of books that have become standard herpetological reference texts. **Venomous Reptiles of North America** is no exception. This book considers the gila monster (*Heloderma suspectum*), and all of the vipers (*Agkistrodon, Crotalus, Sistrurus*) and elapids (*Micruroides, Micrurus, Pelamis*) that range into North America. Each of the 21 species of snakes and lizards is treated individually with a detailed discussion, including distribution, habitat, behavior, reproduction, geographic variation, recognition characteristics and confusing species, food and feeding, venom and bites, predators and defense, populations, growth and longevity. These accounts are well written, concise and thorough. A North American distribution map is provided for each species, numerous photographs are included, and a key is furnished. The author refers readers to texts that fully cover related topics such as taxonomy, snake bite treatment, venom chemistry and pharmacology. The bibliography runs to more than 50 pages. However, Ernst notes that it primarily includes articles and books published between 1955 and September of 1991, and refers interested persons to sources listing pertinent older publications.

There is one area where this book did not live up to my expectations. Many of the photographs, particularly the 55 color plates grouped in the middle of the text, were disappointing, and I suspect that the author was not involved in their selection and layout. Several of the plates have a distinct bluish tinge (for instance, Plate 29, *Crotalus cerastes laterorepens*), and the *Heloderma s. suspectum* in Plate 2 is just plain blue. Another *H. suspectum* in Plate 1 is very pale and washed-out, as are several of the black and white photographs that are scattered throughout the text. A picture of *Sistrurus miliarius barbouri* on page 81 is particularly poor, and would be useless to anyone attempting to use that illustration for identification purposes. Many of the other color photographs are excellent, but are not presented effectively. For instance, Plate 5 is a fine photograph of *Micrurus f. fulvius*. Unfortunately half of the snake was cut from the picture, even though a third of the page width was left as white space. Plates 18, 19 and 20, which nicely illustrate three subspecies of *Sistrurus catenatus* would have been more effective if enlarged. There, also, fully a third of the width of the page is wasted white space. On the facing page, in Plate 22, a photograph of *S. m. miliarius* runs from margin to margin, and shows greater detail.

I also note that although the dangerous venomous snakes are all treated, there is no mention of any of the rear-fanged species that range into North America, such as the *Trimorphodon*. A discussion of these species would have been of interest. I would also have liked some mention of the other North American snakes (i.e., *Heterodon*) which may produce bites that have been reported to effect humans.

Since acquiring this book, I have used it on a regular basis. I found it to be highly readable and interesting. It is well organized and provides a superb, all-around source of information on our native venomous reptiles. **Venomous Reptiles of North America** is a useful text that is well worth its very reasonable cost, and I recommend it to any naturalist with an interest in our venomous reptiles.

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THE MARYLAND NATURALIST'S BOOKSHELF- BOOK REVIEW

Insect Lives: Stories of Mystery and Romance from a Hidden World by Erich Hoyt and Ted Schultz. 1999. John Wiley & Sons, New York. 360 pages. Hardcover, $27.95.

One of the most numerous and diversified groups of all living creatures on our earth today are insects. Although no one knows with certainty how many there really are, current estimates range from three million to 30 million species. E. O. Wilson has estimated that the mass of ants alone is equal to the mass of all humans. Insects fly, jump, walk, swim, spin webs, and burrow through soil and flesh. They occupy the deepest caves and the hottest deserts. Some never see the light of day while others skate across the surface of the ocean. Many insects rank among the most beautiful of all living creatures, while others transmit diseases so devastatingly deadly that their presence has impeded human exploitation of major land areas. Several groups are social, forming complex mega-societies that rival the complexity of our own. Insects have been around since well before the dinosaurs arose, and they will undoubtedly still be around to see mankind exit the stage.

I learned all of these facts from reading **Insect Lives**, a carefully selected collection of essays, articles, poems, cartoons, and even recipes, all having only one thing in common- insects! When I was presented with a copy of this book and asked to write a review, I was concerned that I would not be able to find a block of time sufficient to allow me to sit down and read it critically. However, I was pleasantly surprised to find that this is not a text that needs to be read in one sitting, or even from front to back. Rather, it lends itself to roaming through the pages and picking out bits and pieces here and there. When I opened it, I went to the contents and proceeded to skip around and read pieces that piqued my interest. The length of the selections, ranging from less that a page to more that ten pages, ensured that whatever amount of time I had available, there was always a piece of the appropriate length. Still, the selections are so interesting that in a short time I realized that I had, in fact, read and enjoyed every word. I also found myself wishing that my physician had this volume in his waiting room, instead of those outdated magazines

The editors ranged far and wide in search of suitable material for this book. They included selections from the Bible, horror movie scripts, cookbooks, trading cards, scientific journals, popular cartoons, magazines, and novels. The authors of the pieces in this eclectic compilation include such writers as Charles Darwin, Henry David Thoreau and E. O. Wilson, the poet Robert Burns, cartoonist Gary Larson, and Wired Magazine founder Kevin Kelly, to name just a few. The selections are grouped by general subject matter, and each group is preceded by a useful introduction written by the editors. Scattered throughout the text are interesting line drawings (many from older publications) and photographs.

I enjoyed reading **Insect Lives** so much that I heartily recommend it to any entomologist or naturalist (old or young) who has a curiosity about insects and their not so hidden lives. So, if you are someone, or know someone, who would be interested in learning how fast cockroaches can crawl, why moth ear mites always infest only one ear, the role that maggots and carrion beetles play in murder investigations, what to do if you are ever trapped in an outdoor privy by army ants, what "manna from heaven" was, how some ants become addicted by drug pushing bugs, why swarms of flies show up in basements and attics, and why balloon flies give nuptial gifts to their mates, this book is for you.

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Days Afield: Exploring Wetlands in the Chesapeake Bay Region by Bill Sipple (illustrated by Tom Danielson). 1999. Published by the author (512 Red Bluff Court, Millersville, MD 21108). 558 pages. Soft-cover $19.95, plus $2.00 postage and handling.

The subtitle of this book conveys the essence of this outstanding contribution to the area's natural history. In it, Bill Sipple relates his experiences on seemingly countless field trips to wetlands on Maryland's Coastal Plain. Bill does an exceptional job recounting his adventures with various coworkers, friends, and family over the past 30 years. In addition to the wealth of information on plants and animal species gathered from these trips, he weaves in scientific facts on flora and fauna as well as the exploits of other naturalists exploring wetlands of the Chesapeake Bay Region.

Travel with Bill and colleagues through famous and lesser known wetlands on Maryland's Coastal plain. The book contains ten chapters describing Bill's botanizing and wildlife observation in this region since the 1970's, plus additional ecological information. Chapter one relates trips on the Delmarva Peninsula- freshwater marshes of the Choptank, swamps along the Nanticoke, and the coastal marshes of Chincoteague and Assateague Islands. Chapter two describes his travels to, and the ecology of, freshwater tidal wetlands- the most floristically diverse Chesapeake Bay wetlands. The next chapter relates his trips to brackish marshes on Maryland's lower Eastern Shore and discusses the origin of these marshes, wetland loss at Blackwater, and the area's wildlife. Chapter four "The Saltmarshes of Maryland's Coastal Bays" is followed by a wonderful chapter about the Pocomoke Swamp. Chapter six describes travels along the Nanticoke River, while Chapter seven examines Delmarva potholes, an interesting type of depressional wetland- the name of which was coined by Bill. In Chapter eight, Bill follows the exploits of Dr. Charles Plitt to various wetlands of Anne Arundel County and presents some interesting comparisons between his observations and those of Dr. Plitt made in the early 1900's. Chapter nine is a collection of observations from various trips. The book ends with Chapter ten, describing significant wetlands on Maryland's lower Western Shore associated with upper Coastal Plain streams such as Severn Run, Piscatoway Creek, Mattawoman Creek, Zekiah Swamp Run, and the St. Mary's River. This book is rich with ecological information including tables and discussions of rare species found in numerous areas and wetland types. The book also contains an extensive bibliography of references that will be of interest to readers searching for more information.

People with an interest in natural history and who enjoy following the exploits of others will want to add this book to their library. Readers will also learn the passion that Bill Sipple has for the natural world and will share some of his disappointments about how it has been treated. I highly recommend **Days Afield** to environmentalists, to people with an interest in natural history, and especially to biologists and others working in the environmental field in Maryland, as there is a lot to learn from this book.

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When possible, manuscripts should be submitted on a PC compatible 3.5 inch high density floppy disc. If possible, manuscripts should be prepared in Word Perfect 8.0 or MS Word software (this is particularly important with longer manuscripts). If word processing capability is not available, submit manuscripts typed, double spaced, on good quality bond paper with adequate margins. Authors should adhere generally to the *Council of Biology Editors Style Manual*. However, individuality and readability of writing style are encouraged.

Contributions other that short notes may include a brief informative abstract. Payment of page charges is not required for publication in *The Maryland Naturalist*. However, if funds are available, assistance to offset publication costs would be welcome.

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